THE PENTIUM® II PROCESSOR FOR BUSINESS

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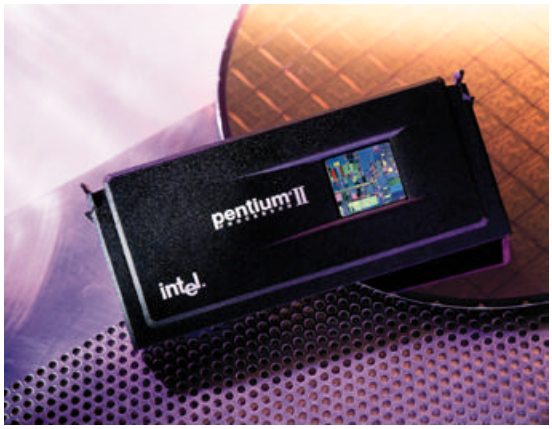

The Pentium® II Processor

Performance data cited in this white paper is excerpted from "Pentium® II Processor Performance Brief," January 1998, order number: 243336-004.

The Pentium® processor, the Pentium processor with MMX™ technology, the Pentium Pro processor and the Pentium II processor may contain design defects or errors known as errata. Current characterized errata are available on request.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Copies of documents which have an ordering number and are referenced in this document, or other Intel literature, may be obtained from:

Intel Corporation
P. O. Box 7641
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1. EXECUTIVE SUMMARY

The Pentium® II processor is the latest addition to the growing family of high-performance Intel microprocessors. It integrates the newest and best features of Intel technology to bring superior performance to the business desktop.

The Pentium II processor combines the Dynamic Execution technology of the Pentium Pro processor with the capabilities of MMX™ technology. These advanced technologies make the Pentium II processor the ideal choice for business computing, especially for the visual computing environment that is fast becoming a new business standard.

Both small and large businesses benefit from the power of the Pentium II processor. It is the fastest Intel processor ever produced, offering the best performance available for a broad variety of applications and advanced operating systems. The Pentium II processor has ample headroom for business media, communication and Internet applications, due to its unsurpassed power in the three important vectors of modern business computing performance: integer, floating point and multimedia.

The Pentium II processor is based on the powerful Dynamic Execution technology that was first introduced in the Pentium Pro processor. Dynamic Execution gives a huge performance boost to modern, 32-bit applications and operating systems.

The Pentium II processor also takes advantage of software designed for Intel MMX technology, to unleash full-screen, full-motion video, enhanced color, smoother graphics and other media enhancements. Many business applications will benefit over time from MMX technology performance.

These applications include:

- office suites
- scanning and printing
- image manipulation
- compression and decompression
- video conferencing
- video editing and playback

The Pentium II processor utilizes the innovative Dual Independent Bus architecture seen in the Pentium Pro processor. It increases bandwidth and performance by enabling the system bus to scale with the processor's core speed.

Systems based on the Pentium II processor also include the latest features to simplify system management and reduce the total cost of ownership for large and small businesses.

Designed for high-performance desktop computers, workstations and servers, the Pentium II processor is compatible with previous Intel Architecture processors. The Pentium II processor family delivers a range of performance, with products at 233 MHz, 266 MHz, 300MHz and 333MHz. All include an integrated, 512-KByte Level-2 cache.

2. BUSINESS BENEFITS OF THE PENTIUM II PROCESSOR

The Pentium II processor offers significant, tangible benefits to business users. These benefits improve overall application and system performance, improve the user's experience of the Internet, intranet and "extranet," and increase the viability of innovative, media-rich and communications applications in mainstream business. As the trend to visual computing and rich media continues to grow, the power of the Pentium II processor will be required for an increasing number of business applications and functions.

The parallelism inherent in the Pentium II processor increases the efficiency of CPU utilization for compute-intensive tasks, including multitasking. This improvement is most dramatic when it affects large data files such as those commonly created in imaging, audio and video applications. With the Pentium II processor, large files can be manipulated, compressed, decompressed, scanned or printed in the background, for example, without sacrificing system performance on foreground applications.

2.1 THREE PERFORMANCE VECTORS

The Pentium II processor offers outstanding performance in the three main vectors of business computing. These are the criteria by which business computing performance is measured: integer, floating point and multimedia. *(For details on Pentium II processor performance with respect to these three vectors, see Figure 1, Page 13).*

Integer performance is a primary contributor to business computing. It is a critical factor for such major business applications as spreadsheets, databases, project management and word processing. Floating point performance governs the computer's ability to process complex data, such as 3D graphics and full-color images. Multimedia processing covers a range of capabilities, including the ability to process repetitive instructions efficiently, boosting compression and decompression speeds and smoothing audio and video reproduction.

The Pentium II processor's success in these three vectors of performance leads to outstanding capabilities in a variety of business applications and usage models. Among them are: multitasking, data compression, imaging (including 3D and rich media), video, conferencing and database management.

2.2 MULTITASKING

For example, while a multi-megabyte file is being downloaded from the Internet, other applications can execute in parallel without sacrificing performance. This multitasking capability increases application performance, system capability and user productivity. Network performance also improves, since the CPU now has more time to service network requests while executing multiple host or server applications that are serviced by the network.

2.3 DATA COMPRESSION

Rapid compression -- and the smaller file sizes that result from improved compression ratios -- combine to reduce network traffic even further. This benefits all network users. The benefits are especially dramatic for mobile or remote users using modems; the improvements are due to a reduction in connection times, file transfer times and storage requirements.

Although compression and decompression algorithms are used most broadly in audio, video and graphics applications, they can promote efficient storage and rapid transmission of any large data files. MMX technology can improve performance of these algorithms significantly. Compression ratio improvements imply smaller compressed files for transmission, reducing network traffic and improving network performance. These optimizations are being included in a wide variety of business applications currently in development.

2.4 IMAGING, 3D AND RICH MEDIA

The Pentium II processor is particularly strong in image manipulation, as applied in computer-aided design, modeling, simulation and authoring of rich documents for electronic and print media.

The processor's speed in rendering three-dimensional objects is vastly improved by the Pentium II processor's excellent floating point performance. This makes 3D imaging accessible for users who design web sites, create presenta-tions or prepare documents for publication.

Other imaging functions such as compositing, blending, anti-aliasing and color space conversion (required to print color images) are compute-hungry functions suited to coding with MMX technology. Many popular imaging applications are optimized for MMX technology, increasing performance still further on the Pentium II processor. By improving the performance and reducing the execution time for complex filters, MMX technology speeds up the iterations that lead to the desired result.

For example, a 50-second reduction in processing time may seem trivial by itself, but it quickly becomes significant for users who typically repeat a step numerous times. The acceleration provided by MMX technology allows trial-and-error by both novice and expert users, putting advanced tools in the hands of non-specialists and small businesses. For experts, this performance boost enables ideas and creativity to flow uninterrupted, often improving the end result.

2.5 VIDEO AND CONFERENCING

The Pentium II processor's power removes some of the barriers to real-time video streaming over the Internet and corporate intranets. Real-time streaming media permits viewing and/or listening while files download from the web, instead of waiting for complete file transfers.

Effective, practical video communications require high-quality image transmission and frame rates which can be difficult to achieve over low-bandwidth communication infra-structures. MMX technology enhances software-only compression optimized for delivering high-quality video over existing networks and corporate LANs. High compression ratios further reduce the burden on network bandwidth.

Businesses that deliver video to the desktop extend the functionality and effectiveness of on-line training, web-based computer help desks, and Internet communications. Pentium II processor-based systems can be used to create and disseminate video-enabled, intranet-based training. This can eliminate the high production and distribution costs of hundreds of hours of videotape-based content. This scheme also ensures central management of content, so employees access only the most current data.

Interactive video conferencing also benefits from MMX technology's acceleration of audio/visual communication, compression and decompression. Pentium II processor-based systems achieve more than twice the frame rates produced by PCs without MMX technology. This facilitates professional quality in video conferencing.[1]

2.6 DATABASE MANAGEMENT

Managing large databases of mixed media assets can be slow or inefficient with traditional databases, because searches on complex data are based on textual file descriptions. The Pentium II processor's MMX technology can improve performance of hybrid-object relational databases, to handle many types of data and retrieve it faster, even with highly complex queries.

[1] Source: Intel tests of ProShare® technology performance on a 106Kbps ISDN line, comparing systems based on a 166-MHz Pentium processor and 233-MHz Pentium II processor.

3. PRODUCT FEATURES

The Pentium II processor uses a combination of four breakthrough technologies to bring the best performance to today's systems:

• **Dynamic Execution:** The Pentium II processor employs this unique combination of processing techniques, first used in the Pentium Pro processor, to speed up software performance.

• **Intel MMX Technology:** Intel's media enhancement technology dramatically improves performance for media and communications applications running on the Pentium II processor.

• **Dual Independent Bus Architecture:** Like the Pentium Pro processor, the Pentium II processor uses the D.I.B. architecture. This high-performance technology combines both a dedicated, high-speed Level-2 cache bus and an advanced system bus, facilitating multiple, simultaneous transactions.

• **Single Edge Contact (S.E.C.) Cartridge:** Intel's new innovative packaging design for this and future processors, the S.E.C. cartridge enables the Pentium II processor's high-performance technologies to be delivered in today's mainstream systems.

• **Manageability:** Systems based on the Pentium II processor include the latest instrumentation and other manageability features. These capabilities, combined with software such as Intel's LANDesk® Management Suite, enable the system administrator to perform many support functions from a central, remote site. The result is a significant reduction in the total cost of system ownership for large and small businesses alike.

4. DYNAMIC EXECUTION

First deployed in the Pentium Pro processor, Dynamic Execution is an innovative combination of three technologies designed to help the processor manipulate data more efficiently. These are: multiple branch prediction, data flow analysis and speculative execution. Dynamic Execution enables the

processor to be more efficient by manipulating data rather than simply processing a list of instructions.

The way software programs are written can influence a processor's performance. For example, software performance will be adversely affected if the processor is frequently required to stop what it is doing and "jump" or "branch" elsewhere in the program. Delays can also occur when the processor is unable to process a new instruction until the current instruction is completed. Dynamic Execution allows the processor to streamline and predict the order of instructions.

Dynamic Execution is comprised of three main elements. They are:

4.1 MULTIPLE BRANCH PREDICTION

Using a multiple branch prediction algorithm, the processor can anticipate jumps in the instruction flow. It predicts where the next instructions can be found in memory with an amazing accuracy rate of 90 percent or greater. This is made possible because, while the processor is fetching instructions, it is also looking at instructions further ahead in the program. This technique accelerates the flow of work sent to the processor.

4.2 DATA FLOW ANALYSIS

With data flow analysis, the processor looks at decoded software instructions and determines whether they are available for processing or dependent on other instructions. The processor then determines the optimal sequence for processing and executes the instructions in the most efficient manner.

4.3 SPECULATIVE EXECUTION

When the processor executes instructions, as many as five at once, it does so using "speculative execution." This keeps the Pentium II processor as busy as possible, resulting in enhanced software performance.

Because the software instructions being processed are based on predicted branches, the results are stored as "speculative results." Once their final state can be determined, the instructions are returned to their proper order and committed to permanent machine state.

5. MMX™ TECHNOLOGY

Intel MMX media enhancement technology includes 57 new instructions oriented to multimedia and communications data types. Intel processors with MMX technology are fully compatible with previous Intel architecture processors; the addition of MMX technology provides supplemental power where it counts the most: in compute-intensive, high-performance applications.

The benefits of the Pentium II processor will become increasingly important as more applications are designed to take advantage of MMX technology. MMX technology improves productivity by enabling the user to run more applications at one time, and by easing the bandwidth limitations that might slow other systems. This increased productivity and usability leads to significant savings by extending the useful life of the system. Modern software applications and operating systems will run faster on the Pentium II processor.

MMX technology is the most significant enhancement to the Intel Architecture in the last 10 years. It enhances the performance of complex, media-intensive and communications applications and enables new features and capabilities. MMX technology will have a long-term effect on mainstream business applications, especially as they continue to provide richer content. This trend is being accelerated in large part by the mass move to Internet and intranet technologies, and the inherently rich, graphics- and media-intensive nature of these environments.

MMX technology embodies new instructions and data types. These instructions and data types can be used by any type of software, not just multimedia applications.

Compression and decompression of files and/or rich content, graphical editing and manipulation, and complex file conversions are examples of common software functionality that will benefit from MMX technology. MMX technology will improve file transfer rates and

boost server and network performance by enabling faster, better compression and decompression, and resulting smaller file sizes. Intel disclosed details about MMX technology almost two years ago. Leading software developers have invested significant resources optimizing applications with MMX technology. Existing mainstream business applications are being revised with MMX technology additions and several announcements are expected shortly.

By accelerating basic underlying operations, MMX technology can yield a tremendous performance improvement. Intel first introduced the Pentium processor with MMX technology and will incorporate MMX technology into all future Intel Architecture microprocessors. The Pentium II processor combines MMX media enhancement technology with the Pentium Pro processor's Dynamic Execution technology. On the Norton* Multimedia Benchmark, the overall score for the 300MHz Pentium II processor was more than 2.2 times that of the 200-MHz Pentium processor.[2]

Those in a position to specify and purchase systems for use with Internet technology need to look forward as they deploy the next wave of information systems. All future Intel micro-processors for PCs will incorporate MMX technology. To provide the most performance headroom for the future, corporations should evaluate and qualify new MMX technology-based systems.

MMX technology brings several tangible benefits to business users. These benefits span the spectrum of increasing overall application, system, and network performance, to expanding and enhancing users' experiences of the Internet, corporate intranets and "extranets," to making innovative, media-rich and communications applications viable in mainstream business.

5.1 DEFINING MMX TECHNOLOGY

MMX technology was designed in a joint effort between Intel's microprocessor architects and the developers from leading software companies. A wide range of software applications were analyzed, including graphics, audio and video, compression and decompression algorithms, speech recognition, image processing, conferencing and others. Advanced computer-aided engineering tools were used to identify the most compute-intensive routines.

Despite the diversity of applications, the analysis revealed several underlying commonalities. Many algorithms used multiple, repetitive loops and operated on small data quantities. While these loops comprised less than 10 percent of the overall application code, they took up to 90 percent of the execution time. These analyses fed the design of MMX technology, which boosts the performance of these frequently executed, common functions with new instructions and enhanced hardware execution capabilities.

New MMX technology instructions allow several small data quantities to be concatenated into a single larger quantity. This facilitates rapid, parallel computations on multiple data quantities at once. For example, graphics information is commonly represented in small, 8-bit, byte-sized quantities. Previously, manipulating eight bytes of graphics data required eight repetitions of a single instruction. The same manipulation can now be performed with a single MMX technology instruction, operating on all eight bytes simultaneously. The result is a dramatic improvement in execution time.

This speedy, parallel processing of combined data quantities is termed the Single-Instruction-Multiple-Data (SIMD) model, in contrast to the older, less-efficient scheme where a single instruction operated on a single piece of data. To provide maximum flexibility, 57 new 'MMX technology instructions' and four new data types were added. These features result in many more calculations performed for each clock cycle of the processor, yielding faster execution times and higher performance.

To accelerate the adoption of this advanced technology, the Intel Architecture MMX technology instruction set was designed and implemented in a transparent way that requires no changes to existing operating systems. All existing software continues to run correctly,

[2] For details, see Figure 5, Page 17.

without modification, on Intel microprocessors that incorporate MMX technology.[3]

6. DUAL INDEPENDENT BUS ARCHITECTURE

In order to meet the demands of applications and to provide headroom for future generations of processors, Intel developed the Dual Independent Bus architecture to address bandwidth limitations in the PC platform architecture.

The Dual Independent Bus architecture was first implemented in the Pentium Pro processor and will become broadly available with the Pentium II processor. Intel created the Dual Independent Bus architecture to improve processor bus bandwidth. Having two independent buses enables the Pentium II processor to access data from both buses simultaneously and in parallel, rather than in the singular, sequential manner employed by single bus systems.

The Dual Independent Bus architecture operates as follows:

• **Two buses** make up the Dual Independent Bus architecture: the "L2 cache bus" and the processor-to-main-memory "system bus."
• **The Pentium II processor** can utilize both buses simultaneously, increasing system efficiency.
• **The Dual Independent Bus** architecture enables high-speed operation of the L2 cache. For example, the L2 cache of the 266MHz Pentium II processor, runs twice as fast as the L2 cache of Pentium processors. As the frequency of future Pentium II processors increases, so will the speed of the L2 cache.

• The pipelined system bus enables multiple, simultaneous transactions instead of singular, sequential transactions. This accelerates the flow of information within the system and boosts overall performance.

Together these features of the Dual Independent Bus architecture offer significant improvements in overall bandwidth performance when compared to a single bus architecture processor. . This high-bandwidth bus technology is designed to work in concert with the high-performance architecture of the Pentium II processor. In addition, the Dual Independent Bus architecture supports the evolution of today's 66MHz system memory bus to higher speeds in the future.

7. SINGLE EDGE CONTACT CARTRIDGE

The Single Edge Contact (S.E.C.) cartridge is an innovative packaging design that enables even higher performance to be delivered to mainstream systems.

Using this technology, the core and L2 cache are fully enclosed in a plastic and metal cartridge. These sub-components are surface mounted directly to a substrate inside the cartridge to enable high-frequency operation. The S.E.C. cartridge technology allows the use of widely available, high-performance industry BSRAMs for the dedicated L2 cache, binging high-performance processing to mainstream price points. Also, this cartridge technology allows the Pentium II processor to use the same high-performance Dual Independent Bus architecture used in the Pentium Pro processor.

The Pentium II processor connects to a motherboard via a single edge connector instead of the multiple pins used in existing PGA packages. Similarly, the Slot 1 connector replaces the PGA socket used in prior systems. Future versions of the Pentium II processor will also be compatible with the Slot 1 connector.

Intel is moving to the S.E.C. cartridge design as the solution for high-performance processors. The first S.E.C. cartridge is designed for single and dual processing desktops, workstations and servers. Later, Intel will optimize S.E.C. cartridge designs for even higher performance workstations and servers, and will design similar, highly integrated solutions for mobile computing systems.

8. MANAGEABILITY

[3] For additional information on MMX technology, visit our dedicated web site at http://www.intel.com/mmx/

In today's business environment, information technology (IT) managers are being called upon to continuously increase efficiency, lower costs and improve customer service. At the same time, business users are demanding more computing power and functionality.

For several years, Intel and the industry have been designing management capabilities into PC and server building blocks - hardware, firmware and software - to enhance their ability to be administered centrally and managed remotely over networks. As part of Intel's Wired for Management initiative, these capabilities are evolving, so that:

- Technical support reps can troubleshoot hardware problems remotely.
- Using applications such as Intel LANDesk® Management Suite, system administrators can inventory hardware and software across the network.
- System managers can install and configure software anywhere in the company from a central, remote location.
- System managers can use built-in capabilities to warn of potential issues with temperature, intrusion, or a full disk drive.
- Management software detects and removes computer viruses before damage occurs.

8.1 TOTAL COST OF OWNERSHIP

According to the Gartner Group, each PC purchased requires an estimated $39,600 in total ownership costs over three years. More than 75 percent of the total cost of owning a networked PC comes from providing support and service.

Choosing the right business computing environment actually reduces the total cost of ownership (TCO) - helping reduce IT budgets and satisfy end users. The more manageable systems provide a robust computing environment, reducing down time and providing a higher return on information technology investments.

9. HIGHEST PERFORMANCE

As businesses look for investment protection and longevity, it makes sense to buy the highest performance available within the desired price range. To truly assess performance over the long run, one should look at measures designed to reflect today's and tomorrow's applications. Besides integer performance, floating point and multimedia performance are also important for advanced office suites, multimedia, Internet and 3D graphics applications.

The right computing environment brings new levels of functionality to business. Here are some examples of what a business user can do with Pentium II processor-based PCs and other high-performance systems:

- Integrated **audio and video** is becoming increasingly important in business computing. Business users can use audio and video capabilities to develop and deliver media-rich training, sales presentations, and customer service functions, as well as exciting Internet and intranet applications.

- The MMX technology of the Pentium II processor improves the performance of a variety of **business imaging** applications, with faster scanning, data compression, image manipulation and printing.

- High-quality **video conferencing** applications can save precious time and money by enabling employees to meet with people around the world while sitting at their PCs. Office workers can share data, video and audio using Intel VideoPhone with ProShare® technology.

- Sophisticated **3D** applications -- including those for product design, data visualization and web authoring -- will execute faster on high-performance Pentium II processor-based desktops and workstations.

- Productivity increases when computer users have the power for true **multitasking**. While waiting for a large file to download from the Internet via modem, for example, a user at a high-performance system has enough power to continue working on another project. The background processing will have little or no discernible effect on the execution speed of foregroud applications.

Pentium II processor-based systems provide the power to operate true multitasking and high-performance applications today, as well as the capability to accommodate new needs tomorrow.

10. CONCLUSION

The Pentium II processor increases system, application and network performance while making innovative applications viable for wide-scale deployment. It provides the power to fuel the current trend to visual computing, as it gathers momentum among large and small businesses worldwide.

The Pentium II processor is unsurpassed in the three important vectors of modern business computing performance: integer, floating point and multimedia. It employs the latest Intel technologies, including Dynamic Execution, MMX technology and Dual Independent Bus architecture, in an innovative single edge contact cartridge.

Pentium II processor-based systems also offer the advanced manageability features to enable remote system management and reduce the total cost of ownership for networked PCs.

Pentium II processor-based systems are an excellent investment for business users. To provide the most headroom for today's and tomorrow's high-performance applications, businesses should qualify and specify Pentium II processor-based systems now .

11. ADDITIONAL INFORMATION

For more information on MMX technology, please consult the following sources, or your system or software vendor.

- World Wide Web:
  http://www.intel.com/businesscomputing
  http://www.intel.com/mmx/
  http://developer.intel.com/drg/mmx
- Intel Literature Center:
  (800) 879-4683
- Intel Customer Support:
  (800) 628-8686

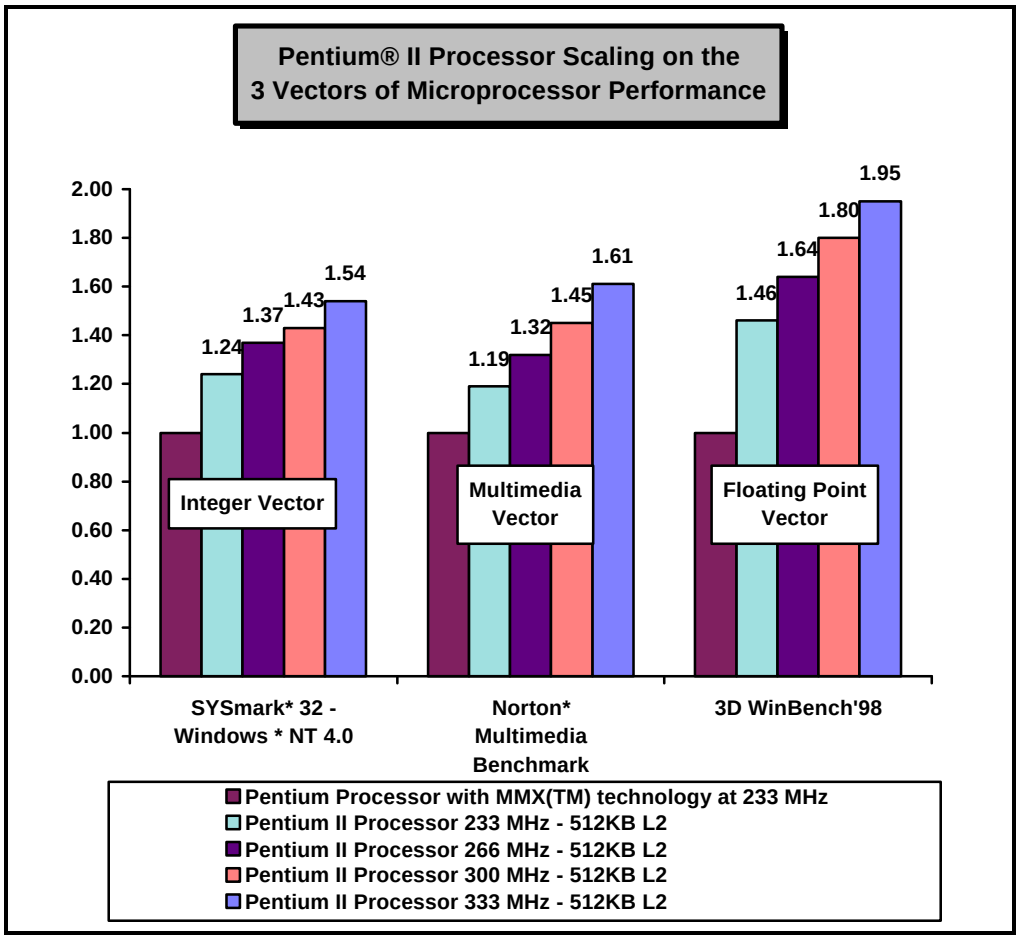
12. Appendix A: Pentium II Processor Performance Data

12.1 Figure 1: Three Vectors of Performance

The microprocessor and the PC of today are designed to run a broad range of powerful software applications. Not every processor is equally capable of the same performance for each type of application. Benchmarks specifically designed for evaluating the performance of processors and systems running integer-, multimedia-, and floating point-intensive applications should be used to look at the complete performance of the processor or the system.

For more information on the individual benchmarks illustrated in the graph below, see the following figures in this document:

- SYSmark*32 for Windows NT* 4.0 Figure 4, Page 16
- Norton* Multimedia Benchmark Figure 5, Page 17
- 3D WinMark* Suite Figure 6, Page 18



Note: *Results are normalized to the 200 MHz Pentium® processor with MMX™ technology. See page 19 for system configuration data.*

12.2 FIGURE 2: INTEGER PERFORMANCE

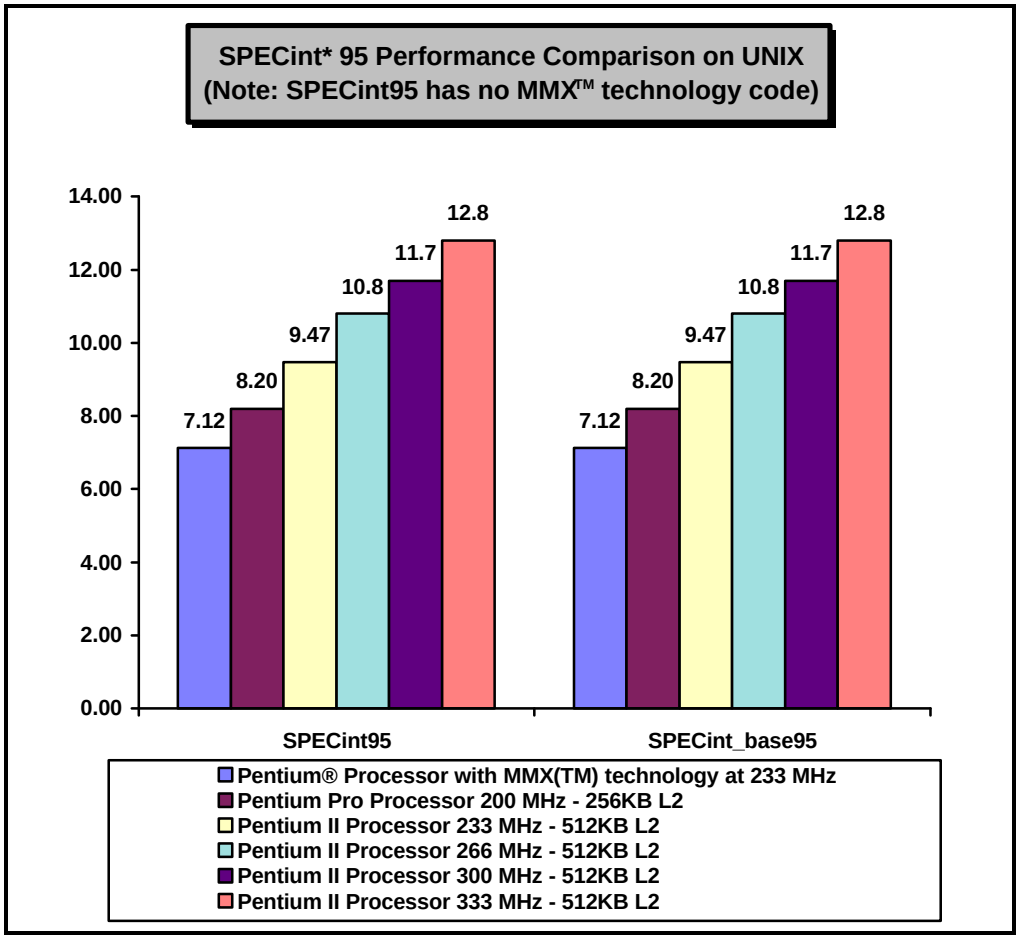
SPEC CPU95* is a software benchmark product produced by the Standard Performance Evaluation Corp. (SPEC), a non-profit group of computer vendors, system integrators, universities, research organizations, publishers and consultants throughout the world. It was designed to provide measures of performance for comparing compute-intensive workloads on different computer systems.

SPEC CPU95* consists of two suites of benchmarks: CINT95* for measuring and comparing compute-intensive integer performance, and CFP95* for measuring and comparing compute-intensive floating-point performance. The two suites provide component-level benchmarks that measure the performance of the computer's processor, memory architecture and compiler. SPEC benchmarks are selected from existing application and benchmark source code running across multiple platforms.

The CINT95 suite, written in the C programming language, contains eight CPU-intensive integer benchmarks. It is used to measure and calculate the following metrics:

- SPECint*95 -- The geometric mean of eight normalized ratios (one for each integer benchmark) when compiled with aggressive optimization for each benchmark.
- SPECint_base*95 -- The geometric mean of eight normalized ratios when compiled with the conservative optimization for each benchmark.

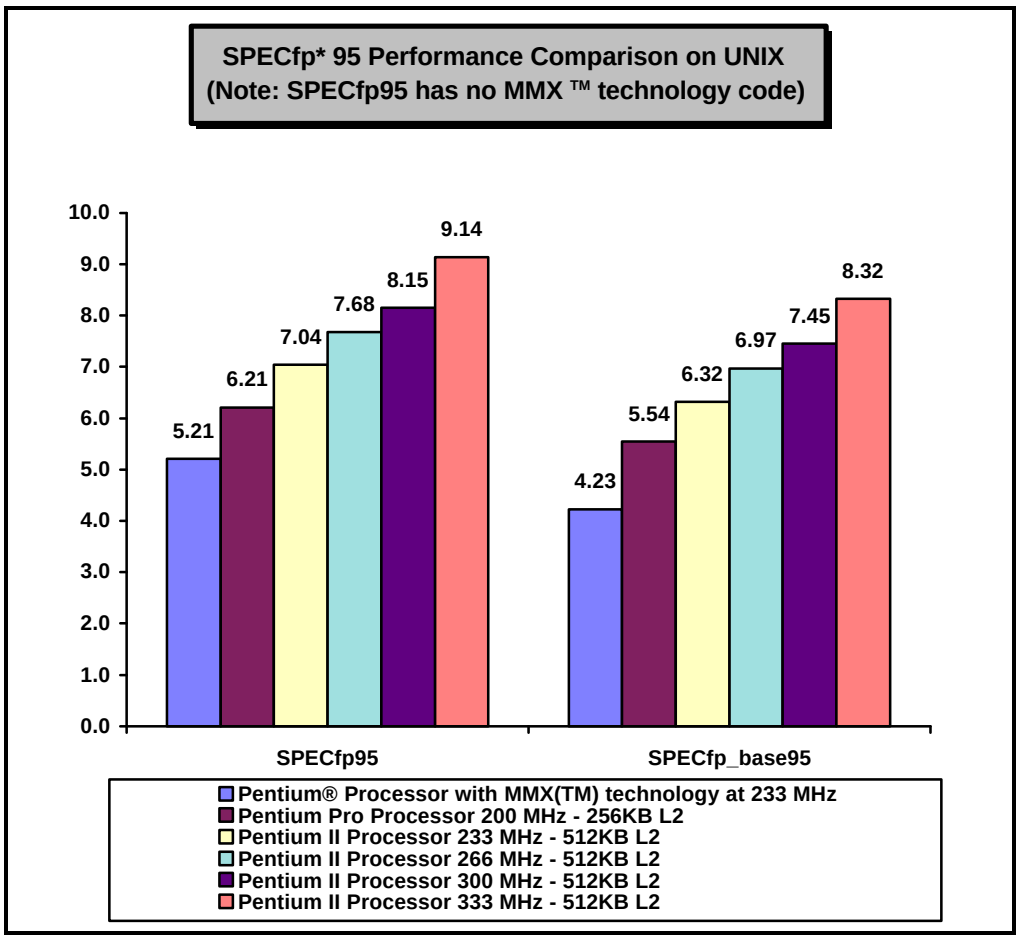
Figure 2 shows the SPECint95 performance. Figure 3 shows the SPECfp95 performance.



***Note**: See page 19 for system configuration data.*

12.3 FIGURE 3: FLOATING POINT PERFORMANCE

For information on this benchmark, see notes to Figure 2, above.



***Note**: See page 19 for system configuration data.*

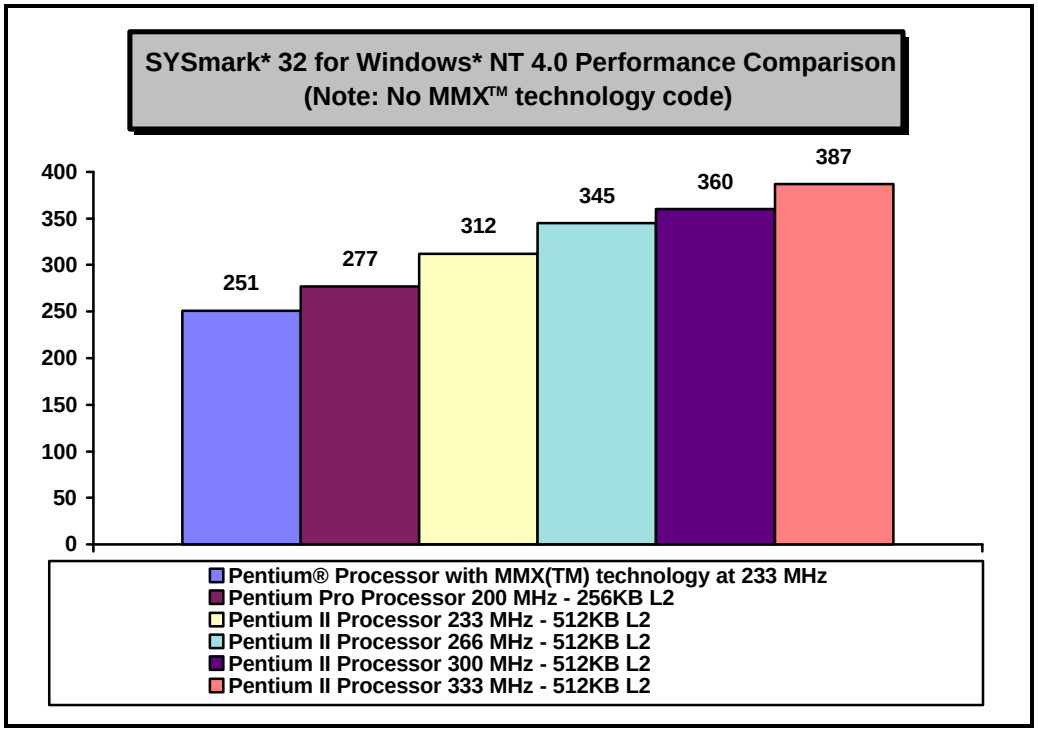
12.4 FIGURE 4: BUSINESS APPLICATION PERFORMANCE

SYSmark* for Windows* 95 and Windows NT* 4.0 is a suite of application software and associated benchmark scripts that have been developed by the Business Applications Performance Corporation (BAPCo), a non-profit consortium of PC OEMs, software vendors, semiconductor manufacturers and industry publications. SYSmark is intended to provide a tool for accurate and realistic measurement of personal computer performance running popular business-oriented applications in the Microsoft Windows operating environment. The scripts are developed to reflect usage patterns of PC users in a business-oriented environment.

SYSmark* includes 32-bit benchmark scripts for the following applications selected from six categories of application software:

- Word-processing — Microsoft Word* 7.0 and Lotus WordPro* 96
- Spreadsheet — Microsoft Excel* 7.0
- Database — Borland Paradox*
- Desktop Graphics — Corel CorelDraw* 6.0
- Desktop Presentation — Microsoft PowerPoint* 7.0 and Lotus Freelance* 96
- Desktop Publishing — Adobe Pagemaker* 6.0

Figure 4 illustrates the SYSmark ratings under Windows NT* 4.0 for the Intel Pentium® II processor.



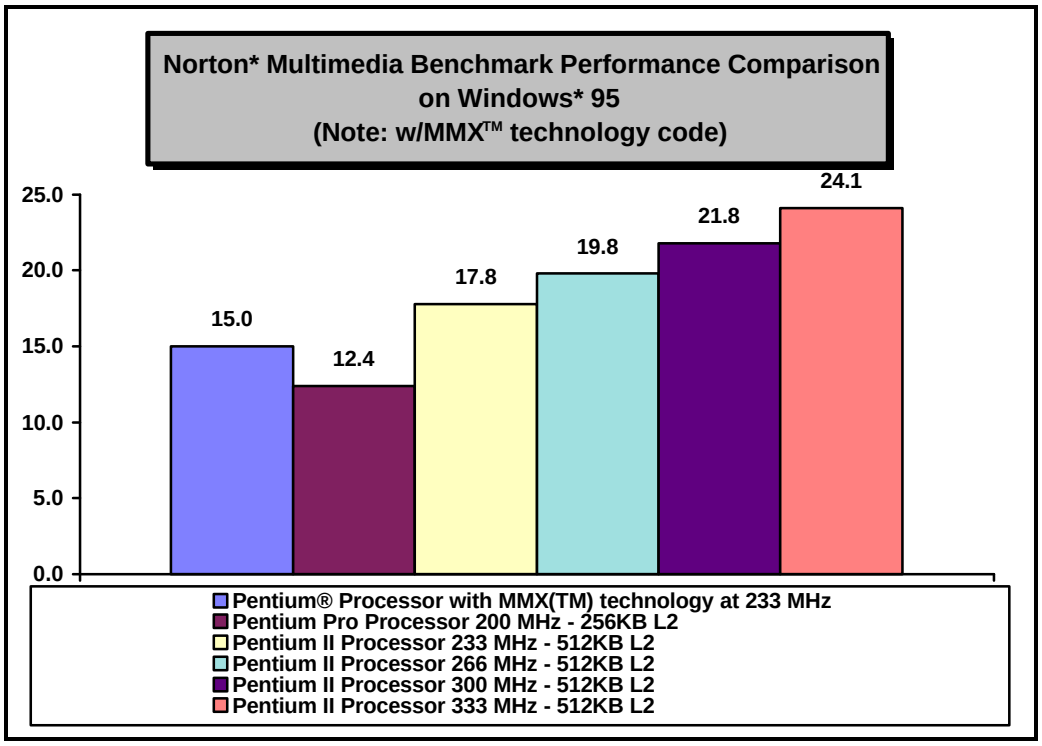
***Note**: See page 19 for system configuration data.*

12.5 FIGURE 5: MULTIMEDIA PERFORMANCE

The Norton* Multimedia Benchmark tests a system's multimedia capabilities and compares the performance to that of a system conforming to the basic Multimedia PC (MPC) Level 2 specification. The benchmark reports performance in five multimedia areas:

- Video - benchmarks video performance, measures MPEG video decompression and AVI video frame rates.
- 3D - tests rendering capabilities.
- Audio - measures audio mixing and MPEG audio performance.
- CD-ROM - measures the CD-ROM drive's maximum seek and transfer rates.
- Imaging - tests image processing manipulations.

The Norton Multimedia Benchmark overall score shows a system's overall multimedia performance rating compared to a standard MPC2 system.



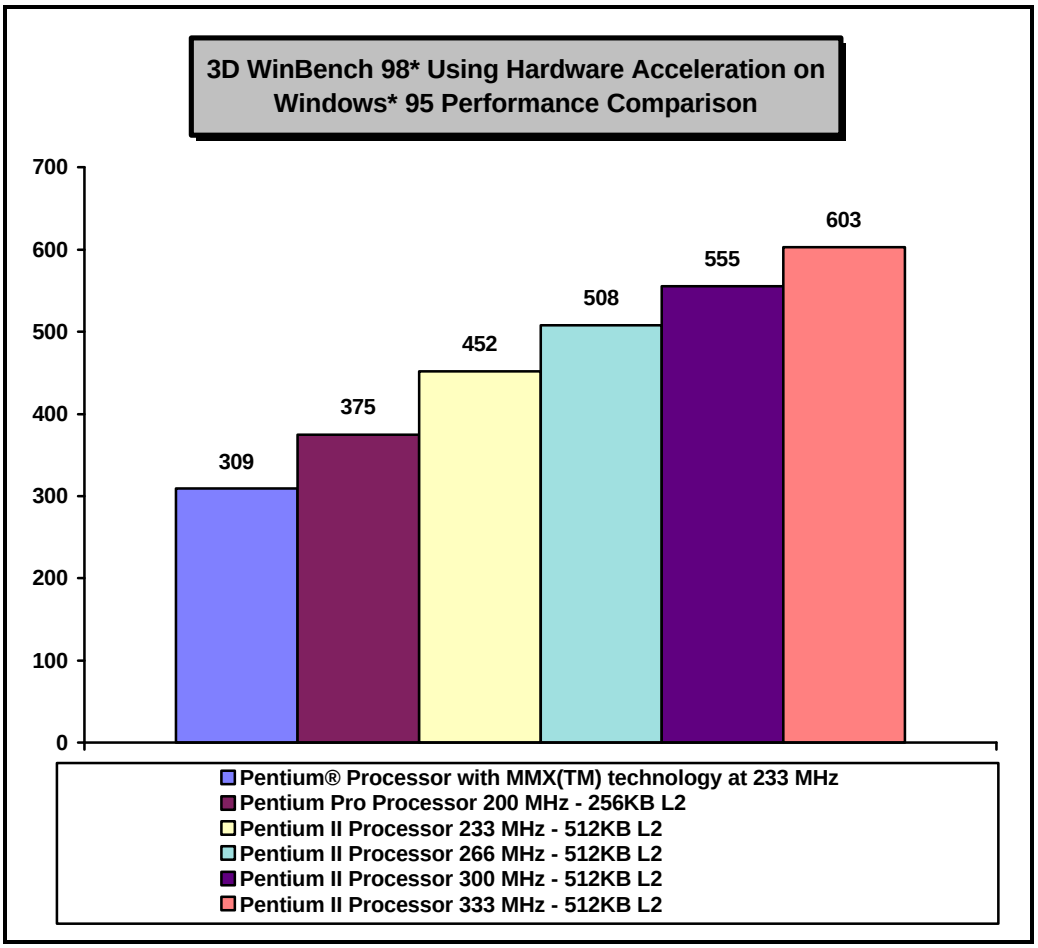
***Note**: See page 19 for system configuration data.*

12.6 FIGURE 6: 3D PERFORMANCE

12.6.1 3D WinBench* 98

3D WinBench* 98, from Ziff-Davis, measures the 3D performance of a computer system (including the microprocessor and the graphics card) using Microsoft's Direct3D* interface under Windows* 95. It includes a series of 19 tests that vary in complexity - the number of triangles they use to form their objects - and the number of quality-enhancing options they employ and the amount of texture they use. The processing includes 3D geometry calculations, which are floating point-intensive, and rasterization. Each test flies through a scene using a predefined path and measures the rendering speed in frames per second. This suite returns an overall, unitless 3D WinMark result summarizing system performance on all tests.

Hardware acceleration is used when all quality-enhancing options for the given test are supported by the underlying hardware. Otherwise, software rasterization using MMX technology is employed if Microsoft's Direct3D software rasterizer supports all the options for the test. If neither the graphics card nor the software rasterizer supports all the options, a score zero is granted. The tests below were run using the STB Velocity 128 card. An AGP-based card was used for all Pentium II processor results, and a PCI-based card was used for Pentium with MMX™ technology and Pentium Pro processor results.



***Note**: See page 19 for system configuration data.*

12.7 SYSTEM CONFIGURATIONS: SPECINT95* AND SPECFP95 ON UNIX*

	Pentium® Processor with MMX™ technology - 233 MHz	Pentium Pro Processor- 200 MHz	Pentium II Processor 233, 266, 300 and 333 MHz[1]
System	Intel 82430 TX PCIset based motherboard	Intel 82440 FX PCIset based motherboard	Intel 82440 LX AGPset based motherboard
Secondary Cache	512 KB WB	256 KB WB	233 and 266 MHz - 512 KB WB 300 and 333 MHz -512 KB WB with ECC
Memory Size	64MB SDRAM	64MB EDO	64MB SDRAM
Video Controller/Bus	Matrox Millennium/ PCI		
Hard Disk Controller	E-IDE/integrated PCI		
Hard Disk	Quantum UDMA	Quantum Fireball 1080 FBA	
Operating System	UnixWare 2.0		
C Compiler	Intel C Ref. Compiler 2.3		
FORTRAN Compiler	Intel FORTRAN Ref. Compiler 2.3		

12.8 SYSTEM CONFIGURATIONS: WINDOWS* 95 AN D WINDOWS NT* BENCHMARKS

Processor	Pentium Processor with MMX™ technology - 233 MHz	Pentium Pro Processor- 200 MHz	Pentium II Processor 233, 266, 300 and 333 MHz[1]
System	Intel 82430 TX PCIset based motherboard	Intel 82440 FX PCIset based motherboard	Intel 82440 LX AGPset based motherboard
FPU	Integrated		
Primary Cache	Pentium Processor - 16 KB (8KB I + 8 KB D) Pentium Processor with MMX Technology - 32 KB (16KB I + 16 KB D)	16 KB (8 KB I + 8 KB D)	32 KB (16KB I + 16 KB D)
Secondary Cache	512 KB WB	256 KB WB	233 and 266 MHz - 512 KB WB 300 and 333 MHz -512 KB WB with ECC
Memory Size	Windows95 and Windows NT 4.0 - 32 MB SDRAM SYSmark/NT and SPEC CPU95 under Windows NT 4.0 - 64 MB SDRAM	Windows95 and Windows NT 4.0 - 32 MB EDO SYSmark/NT and SPEC CPU95 under Windows NT 4.0 - 64 MB EDO	Windows95 and Windows NT 4.0 - 32 MB SDRAM SYSmark/NT and SPEC CPU95 under Windows NT 4.0 - 64 MB SDRAM
Hard Disk Controller/Bus	Adaptec 2940UW* SCSI/PCI		
Hard Disk	Seagate ST34501W		
Video Controller/Bus	For all benchmarks except 3D WinBench 98: Diamond Stealth 3D 2000 Pro*/ PCI For 3D WinBench 98: Pentium with MMX™ technology processor – STB Velocity 128 PCI based Pentium Pro processor – STB Velocity 128 PCI based Pentium II processor – STB Velocity 128 AGP based		
Video Memory Size/Type	Diamond Stealth 3D 2000 Pro - 2 MB EDO STB Velocity 128 – 4MB SGRAM		

Operating System 1	Windows NT* 4.0
Video Driver Revision	Diamond v2.1
Graphics	1024x768 Resolution, 256 Colors
	SPEC CPU95 - Windows NT 4.0
C Compiler	Intel C Compiler 2.4 Plug In
FORTRAN Compiler	Intel FORTRAN Compiler 2.4 Plug In
Operating System 2	**For all benchmarks except 3D WinBench 98 - Windows 95 - Build 1111** **For 3D WinBench 98 - Windows 95 - Build 1212**
Video Driver Revision	For all benchmarks except Norton Multimedia Benchmark and 3D WinBench 98: Diamond Stealth 3D 2000 Pro- Diamond 4.03.00.3205 with Microsoft DirectX 3.0a For Norton Multimedia Benchmark: Diamond Stealth 3D 2000 Pro- Diamond 4.03.00.3205 with Microsoft DirectX 5.0 For 3D WinBench 98: STB Velocity 128 – STB 1.21 with Microsoft DirectX 5.0
Graphics	All benchmarks except Norton Multimedia and Intel Media Benchmarks, 3D WinBench 98 – 1024x768 Resolution, 256 Colors Norton Multimedia and Intel Media Benchmarks - 1024x768 Resolution, 16-bit color 3D WinBench 98 – 640 x 480 Resolution, 16-bit color

NOTE:

1. Frequency set by replacing the processor and setting system jumpers as described in the system documentation.